

## 18.366 Random Walks and Diffusion — Fall 2006 – MIT

**Web Site:** <http://math.mit.edu/18.366>

**Time & Place:** Tuesdays & Thursdays 1:00–2:30pm, Room 2-136.

**Professor:** Martin Z. Bazant, [bazant@mit.edu](mailto:bazant@mit.edu). Office hours: Wed 1-2:30 in 2-363B.

**Teaching Assistant:** Chris H. Rycroft, [chr@math.mit.edu](mailto:chr@math.mit.edu). Office hours: Mon 3-4, Wed 3-4.

**Grading:** Based on problem sets (40%), midterm exam (30%), and final project (30%).

**Problem Sets:** Five, due on Thursdays Sep 21, Oct 5, Oct 26, Nov 9, and Nov 30. You are encouraged to work in groups and consult references (other than solutions to previous 18.366 problems), but you must write up each solution independently, in your own words.

**Take-home Midterm Exam:** One, handed out Nov 14 and due at the next lecture Nov 16.

**Final Project:** There is no final exam, only a written final-project report, due at the last lecture on Dec 12. The topic must be selected and approved by Nov 9.

**Lecture Notes:** Selected notes from previous years (written by student “scribes”) are available at CopyTech or can be downloaded individually from OpenCourseWare.

**Recommended Books:** B. Hughes, *Random Walks and Random Environments*, Vol. 1 (Oxford, 1996). S. Redner, *A Guide to First Passage Processes* (Cambridge, 2001). H. Risken, *The Fokker-Planck Equation* (Springer, 2nd ed., 1989).

**Further Reading:** J.-P. Bouchaud & M. Potters, *Theory of Financial Risks* (Cambridge, 2000). J. Rudnick & G. Gaspari, *Elements of the Random Walk* (Cambridge, 2004). F. Spitzer, *Principles of the Random Walk* (Springer, 2nd ed., 2001).

### Topics:

1. Normal diffusion ( $\approx 12$  lectures). Central Limit Theorem, asymptotic approximations, drift and dispersion, Fokker-Planck equation, first passage, return, exploration.
2. Anomalous diffusion ( $\approx 10$  lectures). Non-identical steps, persistence and self avoidance, Levy flights, Continuous Time Random Walk, fractional diffusion equations, random environments.
3. Nonlinear diffusion ( $\approx 4$  lectures). Interacting walkers, steric effects, electrolytes, porous media, DLA.